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AUTHOR Meyer, Bonnie J. F.
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ABSTRACT

B. J. F. Meyer's approach to prose analysis is utilized in this paper to examine differences in learning and memory of text by readers across the adult lifespan. The analysis system is described briefly and compared to other approaches. Several studies are then summarized that employ this hierarchical analysis system to study learner characteristics of age and verbal ability. The paper concludes from these studies that age appears to influence strategies for deciding what is important to remember from text. It then reports on other studies that show that age and verbal ability appear to influence the ability of learners to utilize conceptual realtionships in hierarchically organized prose. (Author/FL)

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Text Structure and Its Use in the Study of Reading Comprehension Across the Adult Life-Span

Bonnie J. F. Meyer

Arizona State University

Tempe, Arizona 85281

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Text Structure and Its Use in the Study of Reading Comprehension Across the Adult Life-Span

An examination is made of the use of a particular semantic grammar (Grimes, 1975; Meyer, 1975) for the study of differences in learning and memory of text by readers across the adult life-span. First, the semantic analysis (Meyer, 1975a, 1975b, 1977, Note 1) is described briefly and compared to other frequently used procedures. Next, several studies are presented which employ this analysis system and use it to study learner characteristics of age and verbal ability.

Text Structure Analysis

Through this semantic analysis, all of the information from a text can be represented in a tree structure called the content structure. The content structure shows how some ideas in the text are superordinate to other ideas. Some ideas from a text are located at the top levels of the content structure and they correspond to the main ideas, gist, or macropropositions of the text. Other ideas are located at the middle levels and correspond to supporting details, while others are found at the bottom levels of the content structure and correspond to very specific details. The top level ideas dominate their subordinate ideas. The lower level ideas give further information about the ideas above them in the structure.

The interrelationships among these ideas are classified with labels from case grammar (Fillmore, 1968) and semantic grammar of propositions (Grimes, 1975). Case or role relationships from case grammar specify relationships within clauses and simple sentences, while rhetorical relationships from the semantic grammar of propositions specify the relationships

among sentences, paragraphs, and larger text segments. The analysis is a propositional analysis system; certain predicates or relationships dictate moving down a level in the structure and thereby form the hierarchical tree structure.

The rhetorical relationships play a crucial part in the content structure since they interrelate sentences, subordinate certain propositions to other propositions, and give a text its top-level structure. The rhetorical relationships fall into five basic groups (Meyer, Note 1). Antecedent/consequent or covariance rhetorical relationships show a causal relationship between topics. The response rhetorical relationships denotes certain topics as problems or questions and interrelates them to others which serve as corresponding solutions or answers. Comparison relationships contrast differences and similarities between two or more topics. Collection relationships show how ideas or events are related together into a group on the basis of one or more commonality. Description relationships give more information about a topic by presenting subordinate examples, color, or additional qualities.

The content structure depicts three important aspects of text: the top-level structure, the macropropositions and the micropropositions. The top-level structure is the rhetorical relationship that ties all of the propositions in a text together and gives it its overall organization. Top-level structures are typical forms of text by which text types are defined. They are ways of organizing topics, but are independent of the content. For example, the comparison top-level structure is a comparison top-level structure regardless of whether it compares two views on cognitive style or two views on poultry production.

The macropropositions include the top-level structure of a text and the content and relationships in propositions occurring at the top third of the content structure. The macropropositions are the main ideas from passages and are better recalled and retained than the micropropositions found at lower levels in the content structure. In well-written texts, the macropropositions are explicitly stated. In text of poorer quality, macropropositions must be inferred from the micropropositions by the text analyst and reader by processes on the nature of van Dijk's (1977) macrorules of deletion, generalization, and construction.

The micropropositions include the propositions at the middle and bottom levels of the content structure. They consist of events, actions, processes, or states often localized in some setting and described in terms of their participants which are identified by case roles, such as agent and instrument. These propositions are found in clauses and sentences and are connected to each other by referential identity and such rhetorical relationships as collections, descriptions, and antecedent/consequent.

Thus, rhetorical relationships can occur at all three levels of prose. However, they are primarily found in the top-level structure and macropropositions; these levels of analysis are depicted in Figure 1 for a sample text. Rhetorical relationships can be explicitly signaled or implicit. Examples of signaling for comparison rhetorical relationships include "in contrast," "however," "but," and "on the other hand"; for antecedent/consequent relationships they include "therefore," "as a

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Insert Figure 1 about there

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result," "so that," "in order to," and "because." If no signaling is provided by a writer, then the reader must infer an appropriate logical relationship between propositions. When analyzing text where the implicit rhetorical relationship between propositions is not obvious, the relationship can be determined by placing typical signaling words for each of the various types of rhetorical relationships between the propositions and selecting the relationship with the best fit.

In summary, the content structure shows the text's overall organization and the interrelationships between its ideas and their relative importance. As seen in Table 1, these traits of the content structure are the strengths of Meyer's system over other available approaches to prose analysis (Cofer, Scott, & Watkins, Note 2; Meyer & Rice, in press). Kintsch's (1975) system yields a hierarchy depicting relative importance of ideas from the perspective of the text or author; the hierarchy is built on repetition of concepts rather than logical or rhetorical relationships. Less training and judgment are involved in identifying repetition than identifying rhetorical relationships; thus, Kintsch's system is easier to learn and more objective. However, the system lacks well articulated top-level and macrostructures and does not allow investigation or scoring of rhetorical relationships since propositions are the minimal unit of analysis. In contrast, for the Meyer system and the Frederiksen (1975, 1977) system, the concept and the relation are the minimal units of analysis and scored independently. Frederiksen's approach makes more distinctions within certain types of relationships and among types of

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Insert Table 1 about here

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information present in recall protocols. It has been particularly fruitful for the study of inferences. However, this system does not reflect the overall structure of the text nor the emphasis of some ideas and subordination of others. Instead, it attempts to separate the underlying logic and concepts of the text from the text structure in which it was presented. (For further comparisons and examinations of other approaches, such as story grammars, see Meyer & Rice, in press.)

Use of Analysis for Examining Individual Differences

Background studies. In utilizing the prose analysis technique to investigate prose learning, most of my earlier work involved college students as subjects (Meyer, 1975a, 1977; Meyer & McConkie, 1973). Five basic research findings emerged from the investigations with college students. First, ideas which are located at the top levels of the content structure are recalled and retained better than ideas which are located at the lower levels (Bartlett, 1978; Britton, Meyer, Simpson, Holdredge, & Curry, 1979; Meyer, 1975a, 1977; Meyer & McConkie, 1973). Second, discrete pieces of information located high in the structure are more likely to be integrated in memory than those located low in the structure (Walker & Meyer, in press). Third, the type and structure of relationships among concepts in text dramatically influence recall when they occur at the top third of structure; however, when the same relationships occur low in the structure, they affect recall minimally (Meyer, 1975a). Fourth, different types of top-level structures differentially affect recall; conceptually organized comparison (adversative) and antecedent/consequent top-level structures facilitate recall more than attributive, list-like description structures (Meyer, 1977; Meyer & Freedle, Note 3). Fifth, students who are able to identify

and use these top-level text structures remember more from their reading than those who do not (Meyer, 1979, Note 1; Meyer & Freedle, Note 3).

Our initial look at learner variables was an examination of text learning by ninth graders with high, average, and low performance in reading comprehension (Meyer, Brandt, & Bluth, Note 4). Most of the high comprehenders organized their recall protocols into conceptual hierarchies with top-level structures matching the top-level structures of the conceptually organized (comparison and response) texts they read. In contrast, most of the low comprehenders did not and instead organized their recall protocols with the list-like attribution structure. Ability to utilize the top-level structure of conceptually organized text (comparison, response, antecedent/consequent) appears to be related to success in school and probably verbal ability; for example, examine the percentage of students who used the same top-level structure as the text for the following types of learners: low ninth-grade comprehenders (24%), average ninth-grade comprehenders (47%), high ninth-grade comprehenders (72%) (Meyer, Brandt, & Bluth, Note 4); junior college students (50%) (Meyer, Rice, Bartlett, & Woods, Note 5); college undergraduates (80%) (Meyer, 1975a); and graduate students (85-100%) (Meyer, in press; Meyer & Freedle, Note 3).

Age-related research. Our examination of age-related differences in prose recall utilizing the content structure analysis has brought learner variables into focus as a primary issue. Although much age-related research has been conducted on memory, little has used text materials. Age-related deficits have been found in most studies using traditional verbal learning paradigms (Denney, 1974; Hultsch, 1974; Taub, 1974; Canestrari, 1968), as well as those with prose (Cohen, 1979; Craik, 1968; Gordon & Clark, 1974;

Schneider, Gritz, & Jarvik, 1975). One of the best supported explanations for these deficits has been an age-related decrement in organizational processes of memory (Craik, 1979; Denney, 1974; Gordon & Clark, 1974; Hultsch, 1974). If older adults do suffer from such an organizational deficit, this will have important implications for their ability to remember information from prose. Specifically, it would predict not only lower quantities of recall for the aged, but less ability to follow the author's structure and less sensitivity to the hierarchical content organization of a passage. Thus, application of the content structure analysis to learning and memory across the adult life-span appeared to be a potentially productive match.

Our investigations (Meyer, Rice, Knight, & Jessen, Note 6, Note 7) in this area examine two major issues with old, middle, and young adults. One compares age groups with respect to their recall of ideas from different levels in the content structure. The other compares recall of passages organized with two different types of top-level structures (comparison: adversative and description: attribution).

Data on these issues comes from several sources. Two experiments (Meyer, Rice, Knight, & Jessen, Note 6, Note 7) were conducted using 48 paid volunteers (30 female and 18 male), all students or alumni of Arizona State University equivalent on years of schooling ($\bar{X}$ = 15 years) and vocabulary scores (Md = 77%), in three adult age groups: old, middle, and young. Two experiments were conducted with retired old adults with lower educational levels ($\bar{X}$ = 13) and lower vocabulary scores (Md = 20%). Currently we are involved in two large scale experiments with high and low verbal ability adults from each of the three age groups.

The studies with the three age groups of high verbal ability showed no age differences in measures of total recall, use of author's organization in recall, nor in ability to recall main ideas. However, task familiarity was a significant factor in prose recall for older adults; their recall of the first passage read was considerably poorer than young adults but on the second and third passages read there were no age-related differences in total recall. Although differences did not appear in total recall, they were found in types of information recalled. All age groups recalled the main idea or central premise of the text (ideas at extreme top of the content structure), but they differed in their recall of lower level information. An age x content structure level interaction was significant ($p < .01$) for probed recall data (questions) and approached significance ($p = .053$) for the free recall data (see Figure 2). Overall, more information was remembered from high levels in the content structure than medium or low. However, this levels effect was strongest for young adults, with the middle and old adults exhibiting nearly equivalent amounts of main ideas, supporting ideas, and details. Analysis of the content of the idea units recalled and questions answered correctly by subjects in different age groups indicated that young adults remember more information supporting the primary thesis of the passage while middle and old adults tend to pick up more details. This is taken as evidence that the different age groups are employing different reading strategies, with the young group being particularly sensitive to the hierarchical structure of the passage.

Insert Figure 2 about here

A study with retired adults indicated that signaling (Meyer, 1975a) which emphasizes text structure can alter the reading strategies of older adults to parallel the levels effect pattern found in recall protocols of young adults. Because of this finding and the similarity in recall of middle and old adults, these differences in types of information recalled were attributed to effects of schooling rather than organizational deficits in the aged. Further investigations are currently being pursued on this topic (Meyer & Rice, Note 8).

The data are summarized in Table 2 from several studies comparing recall of passages organized with adversative (comparison) and attribution (list-like) top-level structures. We propose that learner characteristics of age and verbal ability influence ability to utilize conceptual and hierarchical relationships in hierarchically organized prose. The adversative prose referred to in Table 2 contains two more conceptual relationships (comparative and causal) (Meyer & Freedle, Note 3) and more hierarchical levels than the list-like attribution structure. Utilization of the structure of the adversative passage is hypothesized to promote more activities of comparing and interrelating ideas and thus result in deeper processing and facilitated recall. However, inability to utilize a conceptual hierarchy is proposed to result in the default mode of storing information in list formats. In addition, matching passage type to ability to utilize conceptual hierarchies is expected to facilitate learning. For example, in Table 2 high verbal adults perform better on adversative passages than attribution passages. However, for the low verbal older

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Insert Table 2 about here

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adults matching passage structure to their list-like strategy is the explanation given for the superior performance on the attribution text as compared to the adversative. We posit a deficit for old adults with low verbal ability to utilize conceptual hierarchies under any conditions. However, we suspect the young adults of low verbal ability will be able to utilize them under optimal conditions. Currently we are investigating this issue (Meyer & Rice, Note 8).

In conclusion, this prose analysis approach is proving valuable for studying individual differences in prose learning. Its use in the study of aging has much potential for theoretical, practical, and knowledge gathering concerns.

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Table 1

Comparison of Strengths (+) for the Major Discourse Analysis Systems

Used in Educational Research Which Have Applicability to

Most Types of Classroom Learning Materials

Analysis Systems	Overall Structure: Articulation & Classification	Hierarchical Structure: Reflection of Subordination & Text Based Importance	Logical Relations: Examine & Score	Finer Distinctions: Semantic & Causal Relations; Substantive Recall	Learning Time: Simplicity	Objectivity: Fewer Judgments Required
Frederiksen			+	+		
Kintsch		+			+	+
Meyer	+	+	+			

Table 2

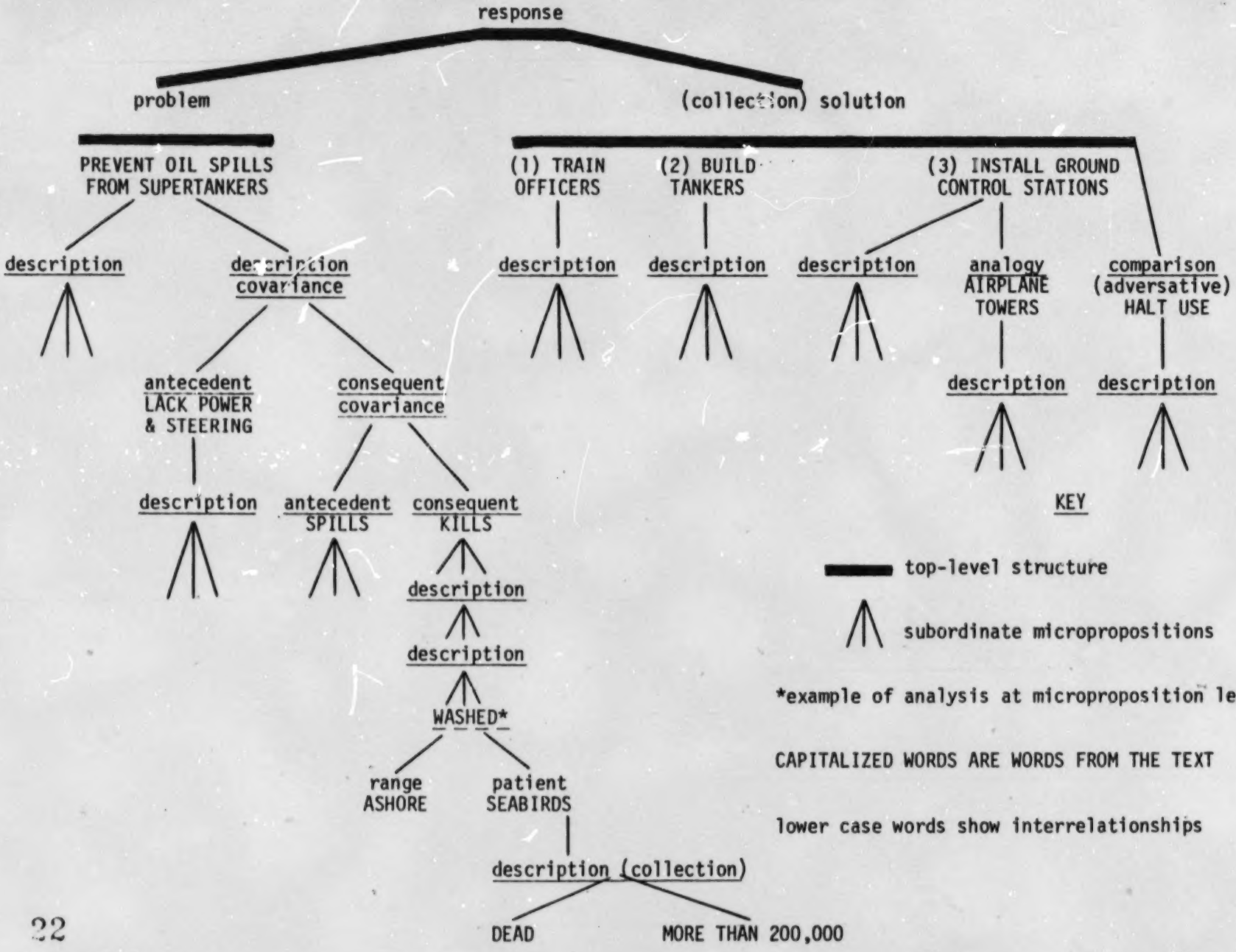
A Composite of Results from Preliminary Studies Examining the Relationship Between Discourse Types and Learner Characteristics of Age and Vocabulary Test Performance

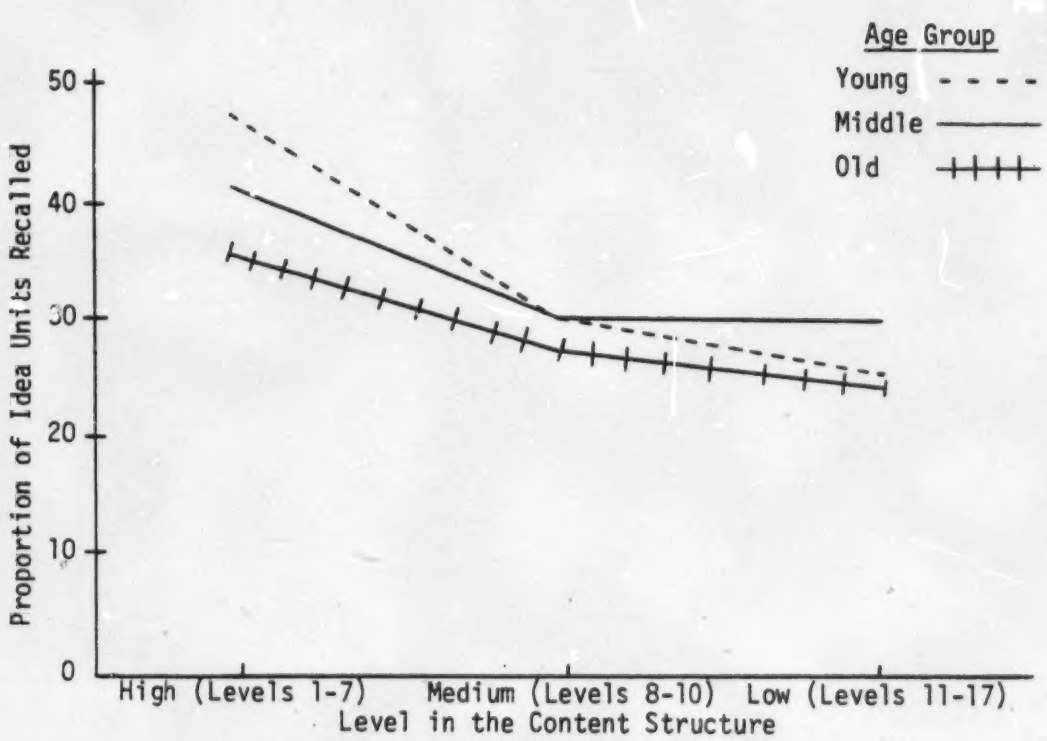
Learner Characteristics		Comparison of Recall of the Same Information from Passages with Adversative and Attribution Top-Level Structures
Age	Verbal Ability	
Old (62+)	High (Md = 77%)	Adversative (53%) > Attribution (34%)
	Low (Md = 20%)	Adversative (27%) < Attribution (48%)
Middle (40-54)	High	Adversative (48%) > Attribution (38%)
	Low	no data
Young (18-32)	High	Adversative (66%) > Attribution (49%)
	Low	no data

Figure Captions

Figure 1. Meyer analysis showing top-level, macropropositions, and example of micropropositions for text from a magazine article on supertankers.

Figure 2. Proportion of idea units recalled from high, medium, and low levels in the content structure by young, middle, and old adults.


response
problem
(collection) solution
PREVENT OIL SPILLS FROM SUPERTANKERS
(1) TRAIN OFFICERS
(2) BUILD TANKERS
(3) INSTALL GROUND CONTROL STATIONS
description
description covariance
description
description
description
analogy AIRPLANE TOWERS
comparison (adversative) HALT USE
antecedent LACK POWER & STEERING
consequent covariance
description
description
description
description
antecedent SPILLS
consequent KILLS
description
description
WASHED*
range ASHORE
patient SEABIRDS
description (collection)
DEAD
MORE THAN 200,000
KEY
top-level structure
subordinate micropropositions
*example of analysis at microproposition level
CAPITALIZED WORDS ARE WORDS FROM THE TEXT
lower case words show interrelationships


Age Group
Young
Middle
Old
50
40
30
20
10
0
Proportion of Idea Units Recalled
High (Levels 1-7)
Medium (Levels 8-10)
Low (Levels 11-17)
Level in the Content Structure